

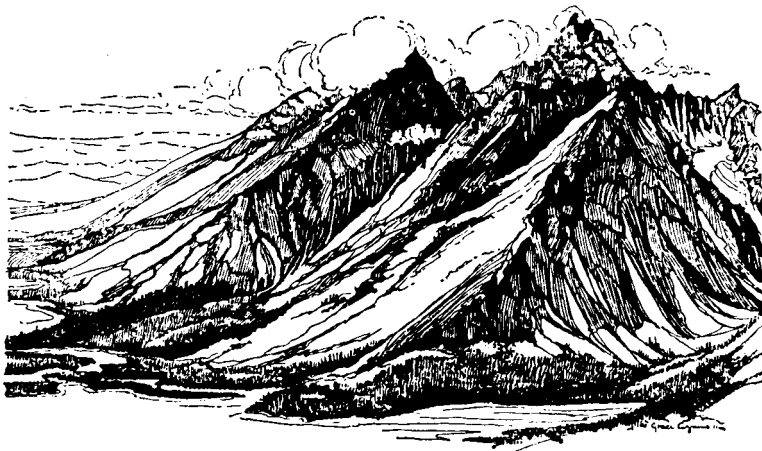
Grand Teton

John D. Rockefeller, Jr., Memorial Parkway

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Journey Through the Past: A Geology Tour

Read the past as you view the Teton Range today. The ancient geologic processes that shaped the mountains and valley have left visible marks. Watch millions of years of dynamic geology unfold before you while exploring Grand Teton National Park.



Rock Formation

The geologic story of this range starts with the formation of the rocks that make up the mountains, rocks far older than the mountains themselves. The process began over 2.5 billion years ago when sand and volcanic debris settled in an ancient ocean. For millions of years, additional sediment was deposited and buried within the earth’s crust. Heat and pressure metamorphosed (changed) the sediment into gneiss, the rocks that comprise the main mass of the Teton Range. The stress of metamorphosis caused minerals to segregate. Today, alternating light and dark layers identify banded gneiss, readily seen in Death Canyon **2** (numbers refer to map on back) and other canyons in the Teton Range.

Next, magma (molten rock) forced its way up through cracks and zones of weakness in the gneiss. This igneous (formed by heat) rock slowly cooled, forming light-colored dikes of granite, inches to hundreds of feet thick. Look for larger dikes as you view the mountains from the Jenny Lake **9** and String Lake **10** areas. Uplift and erosion have exposed the granite that now forms the central peaks of the range **6** and **7**.

Diabase, a dark-colored igneous rock, 1.3 billion years ago flowed up through the gneiss and granite, resulting in the prominent vertical dikes seen today on the faces of Mt. Moran **12** and the Middle Teton **6**. The diabase dike on Mt. Moran protrudes from the face because the gneiss surrounding it erodes faster than the diabase. The

diabase dike on the Middle Teton is recessed because the granite of the central peaks erodes more slowly than the diabase.

Shallow seas that covered the Teton region 600 million to 65 million years ago have left sedimentary formations, still visible at the north and south ends of the Teton Range and also on the west slope of the mountains. Marine life, especially tiny trilobites, corals and brachiopods, flourished in the shallow seas covering this area.

The seas repeatedly advanced and retreated. During retreat of the younger seas, this area became a low-lying coastal plain frequented by dinosaurs. Fossilized bones of a horned dinosaur, the *Triceratops*, have been found east of the Park near Togwotee Pass **20**.

Mountain Building

Compression of the earth’s crust 80 million to 40 million years ago caused uplift of the Rocky Mountain chain, from what is now Mexico to Canada. While the mountains on the south **1** and east **18** formed during this period, the rise of the Teton Range as we now see it had not yet begun.

Stretching and thinning of the earth’s crust caused movement along the Teton fault to begin about 6 – 9 million years ago. Every few thousand years, when the elasticity of the crust stretches to its limit, a fault or break of about 10 feet occurs, relieving stress in the earth’s crust. The blocks on either side of the fault moved, with the west block swinging skyward to form the Teton Range, the youngest and most spectacular range in the Rocky Mountain chain. The east block dropped downward, forming the valley called Jackson Hole. The valley block under your feet has actually dropped down four times more than the mountain block has uplifted.

Total vertical movement along the Teton fault approaches 30,000 feet. Evidence for the amount of movement comes from the present location of Flathead Sandstone. Activity along the Teton fault separated this

formation on the opposing blocks. On the summit of Mt. Moran **12**, 6,000 feet above the valley floor, lies a pink cap of Flathead Sandstone, visible when the snow has melted. On the valley side of the fault, this formation lies buried at least 24,000 feet below the surface.

Early nineteenth century fur trappers referred to high mountain valleys as “holes.” When they named this valley Jackson Hole, they were geologically correct! Today the sheer east face of the Teton Range, rising abruptly more than a mile above the valley, captures our attention more than the valley does. Rocks and soil, thousands of feet thick, transported into the valley over the past several million years, mask the subsidence of the valley.

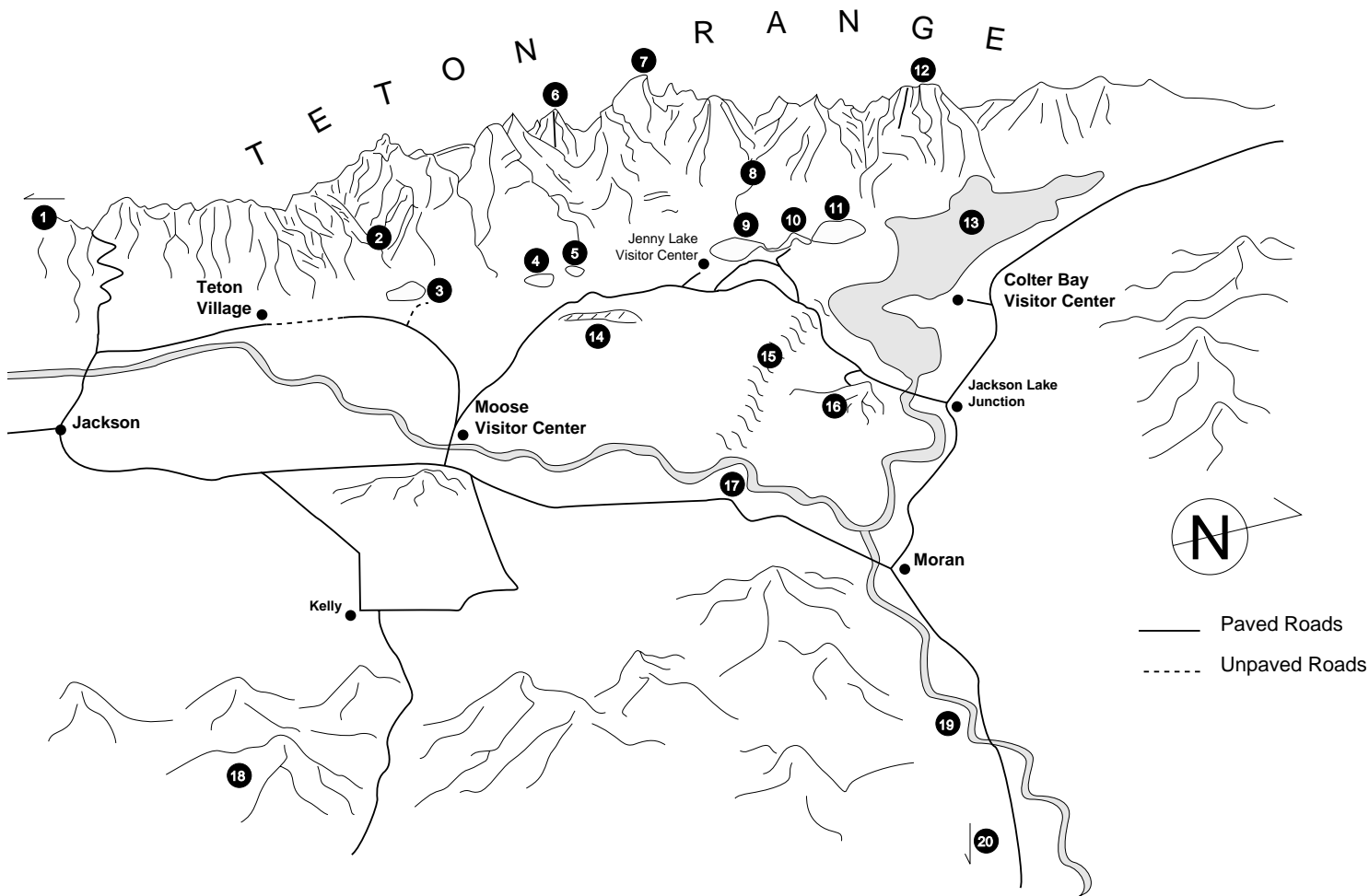
Some of the deposits filling Jackson Hole contain innumerable rounded rocks varying in color from white to pink and purple. These quartzite rocks eroded from an ancestral mountain range probably located 20 to 70 miles northwest of the Teton Range. Rivers rounded the quartzite into cobblestones as they carried the rocks into this area.

Vulcanism

Vast clouds of volcanic ash blew into the Teton region from the west and north, beginning more than 20 million years ago. White ash accumulated on the sinking floor of Jackson Hole 9 million to 10 million years ago, leaving deposits nearly one mile thick. Between 6 million and 600 thousand years ago, fiery incandescent clouds of gaseous molten rock originated in what is now central Yellowstone Park and flowed southward on both sides of the Teton Range. Remnants of this flow are exposed on Signal Mountain **16** and on the north end of the Teton Range.

Collecting Rocks

Park law prohibits collecting. Please leave rocks where you find them so that others may enjoy the intact geologic story.



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|---------------------|--------------------|-------------------------|
| 1 Snake River Range | 8 Cascade Canyon | 15 Burned Ridge Moraine |
| 2 Death Canyon | 9 Jenny Lake | 16 Signal Mountain |
| 3 Phelps Lake | 10 String Lake | 17 Snake River Overlook |
| 4 Taggart Lake | 11 Leigh Lake | 18 Gros Ventre Range |
| 5 Bradley Lake | 12 Mount Moran | 19 Buffalo Valley |
| 6 Middle Teton | 13 Jackson Lake | 20 Togwotee Pass |
| 7 Grand Teton | 14 Timbered Island | |

Glaciation

The sculpturing influence of ice has provided a final spectacular touch to a scene that already boasted mountains rising sharply from a broad, flat valley. About 150,000 years ago this region experienced a slight cooling that allowed an accumulation of more and more snow each year. Eventually glaciers (masses of ice) began to flow from higher elevations. Over two thousand feet thick in places, the ice sheet flowed from north to south through Jackson Hole. The glacier finally halted south of the town of Jackson and melted about 100,000 years ago. About 60,000 years ago the glaciers returned, first surging from the east down the Buffalo Valley 19, stopping near the Snake River Overlook 17. The most recent ice advance flowed from the Yellowstone Plateau south down the Snake River drainage and east from the canyons in the Teton Range, about 20,000 years ago. The Yellowstone ice mass gouged out the depression occupied today by Jackson Lake 13.

Smaller glaciers flowing eastward down the Teton Range broadened the V-shaped stream canyons into U-shaped canyons, typical evidence of glaciation. Ice flowed from the canyons into Jackson Hole, then melted to form the basins that small lakes occupy today. Glacial lakes include: Phelps 3, Taggart 4, Bradley 5, Jenny 9, String 10 and Leigh 11.

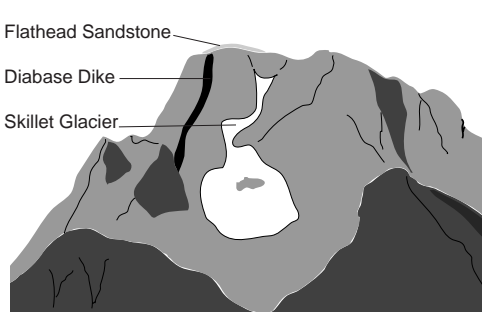
As glaciers flowed down the canyons, rocks and ice smoothed and polished canyon floors and walls. Look for glacial polishing today in Cascade 8 and other canyons. Other telltale signs of glaciation include cirque lakes high up in the canyons, such as Lake Solitude in the north fork of Cascade Canyon. The peaks of the Teton Range became more jagged from frost-wedging, where water freezing in the rocks exerted a prying force, eventually chiseling the rocks free, leaving the sharp ridges and pinnacles seen today.

Although the last great ice masses melted about 15,000 years ago, a dozen re-established glaciers still exist in the Teton Range. Mt. Moran 12 exhibits five glaciers: Triple Glaciers on the north face, prominent Skillet Glacier on the east face and Falling Ice Glacier on the southeast face. Teton Glacier lies in the shadow of the Grand Teton 7. One way to view a glacier up close involves a ten-mile hike (twenty miles roundtrip) up the south fork of Cascade Canyon 8 to Schoolroom Glacier. It demonstrates all the features of a classic glacier.

Moraines (deposits of glacially-carried debris) accumulated at the terminus of each ice surge. Because moraines contain a jumble of unsorted rocks and soil that retains water and minerals, glacial debris today supports dense lodgepole pine forests. To locate moraines, look for large stands of pines on ridges

projecting above the valley floor, such as Timbered Island 14 and Burned Ridge 15. Glacial moraines also surround the lakes at the base of the peaks.

Where glacial meltwater washed away most of the soil, the cobbles and poor, thin soil left behind cannot retain moisture or nutrients. Sagebrush, certain wildflowers and grasses can tolerate such desert-like growing conditions. Thus the geologic history of a region determines the vegetation and ultimately the wildlife, too.



Mount Moran

As you enjoy the scenic beauty of the Teton Range and Jackson Hole, remember that the physical forces that created these features still exert their influence. Mountains continue to rise, while erosion by wind, water and ice pares the mountains down. And so the story never ends.